

NASA Dryden's UAS Service Capabilities

The vision of NASA's Dryden Flight Research Center is to "fly what others only imagine." Its mission is to advance technology and science through flight. Objectives supporting the mission include performing flight research and technology integration to revolutionize aviation and pioneer aerospace technology, validating space exploration concepts, conducting airborne remote sensing and science missions, and supporting operations of the Space Shuttle and the International Space Station.

The Center has been instrumental in many aviation advances including the first supersonic flight by the X-1 rocket plane in a joint NACA, Army Air Forces, and Bell Aircraft research program. The Center has since been directly involved in many important technological milestones in aviation and space access: supersonic and hypersonic flight, digital fly-by-wire control systems, supercritical and forward-swept wings, and development and operational support of the Space Shuttles. The Center was also where the Apollo program's Lunar Landing Research Vehicle, the famed X-15 rocket plane, and the wingless lifting bodies were tested during the 1960s and 1970s.

Currently, the Center is supporting the multi-national effort to explore our solar system by leading the operational aspects of testing the abort system for the Orion crew exploration vehicle. The Center continues to provide flight services to the international science community through NASA's Airborne Science Program by conducting flight operations around the globe in an effort to collect data to help us understand the complex environmental processes of our planet. The Center also continues to advance the state of the art in aeronautical sciences through a variety of aeronautics research activities.

A significant focus of effort in recent years has been on Unmanned Aircraft Systems (UAS), both in support of the Airborne Science Program and as research vehicles to advance the state of the art in UAS. Additionally, the Center has used its piloted aircraft in support of UAS technology development. For example, the Center has used its Gulfstream III aircraft as a surrogate unmanned aircraft for sensor and algorithm development and has used its high-performance fighter aircraft to validate autonomous aerial refueling algorithms.

In order to facilitate greater access to the UAS expertise that exists at the Center, that expertise has been organized around three major capabilities. The first is access to high-altitude, long-endurance UAS. The second is the establishment of a test range for small UAS. The third is safety case assessment support.

The Center has acquired an MQ-9 Raptor (Predator B) and associated ground support and control equipment and is in the process of receiving two early development versions of the Global Hawk from the U.S. Air Force. The MQ-9 has been named Ikhana by NASA and should be operational by the time this article is published. Ikhana already has a busy manifest for the balance of 2007, however, depending on the complexity of the specific test requirements, additional flight opportunities may still be available this year. The

readiness of the Global Hawk airframes is dependent on the demand for them and the speed with which the supporting ground infrastructure can be developed. In the short term this infrastructure is available to the Center on loan from the U. S. Air Force but will limit operations to the local area around Edwards Air Force Base.

At the other end of the UAS capability spectrum are the small UAS and the challenge of finding suitable locations from which to conduct development testing of these vehicles. In cooperation with the U. S. Air Force at Edwards Air Force Base, NASA is creating a test area for small UAS that can be used by industry and the international community to enable developmental testing, acceptance testing, or capability demonstration for potential customers. The test area is being established in response to the need of the industry to legally conduct research and development activities in the interim while the Federal Aviation Administration (FAA) develops policy and regulation to allow such activities to occur in civil airspace, and to respond to the increasing use by NASA and the Department of Defense of small UAS to conduct basic aeronautics research.

Located approximately 700 meters (2300 feet) above sea level in the Mojave Desert, the test range at Edwards provides many opportunities for small UAS testing. The dry lakebeds, clear skies, and low humidity provide ideal test conditions for many types of UAS testing. NASA has used several locations on the base over the years for UAS testing of all kinds. What distinguishes this test area from prior UAS operations areas is the fact that a block of airspace will be designated for small UAS operations, thus allowing UAS operations to be scheduled on a routine basis. In the past, UAS operations were conducted in airspace available to all users on the range and as such could be out-prioritized.

The test area will be based at an improved landing strip in a remote area of the base. From this airstrip, line-of-sight flight operations can be conducted. If flight operations require, a nearby section of airspace 9.26 kilometers (5 nautical miles) in diameter up to 914 meters (3,000 feet) can be activated. This remote location is ideal for testing proprietary configurations. This area is accessed via an improved dirt road.

In addition to a specific area being designated, a streamlined approval process and standard agreements are being developed in an effort to reduce the time required to obtain test approval and to reduce the cost to the user and to the government of providing the service.

The third capability area is the resident system expertise available to assist the global UAS community (government and industry) in obtaining mission approval or certification. The rapid proliferation of UAS, and in particular small UAS, has allowed non-traditional aerospace users and developers to acquire or produce UAS. Lack of experience with flight/mission planning, flight safety approval processes, or system safety has hindered the effective utilization of some systems.

Specific to UAS operations, NASA Dryden has developed the Joint Advanced Range Safety System (JARSS) software to assist the UAS community in assessing the risk to the

public of conducting flights outside traditional Range airspace boundaries. This software assists in developing flight routes that minimize the risk to the public in the event of an accident. The software uses demographic data as well as vehicle reliability data to compute a causality expectation. This can be a powerful tool in making the safety case in applications for Certificates of Authorization.

Over the years NASA Dryden has established a robust system safety analysis capability associated with aircraft and aircraft systems. This expertise is available to assist the UAS community by providing overall or specific subsystem safety analysis and assessment. The approach is especially well-suited to collecting the information necessary to submit an application for experimental certification of a new unmanned aircraft system or to assist other government agencies in obtaining a certificate of authorization from the FAA for operations of an unmanned aircraft system in U.S. civil airspace.

Specific skills, such as fault tree analysis, can be applied to systems or operational concepts to assist the developer in identifying potential vulnerabilities in their design, allowing them to design out potential deficiencies, thus improving reliability and the chances of obtaining greater operational access to civil airspace. Likewise, the experts at the Center can be helpful to potential operators of UAS by helping them to establish the necessary processes and expertise to ensure safe, reliable operations of the systems they are acquiring.

In these ways NASA Dryden is trying to aid the international UAS community by applying its skills to acquire the data needed by the regulatory agencies to make informed decisions, supporting operations to further mature UAS capabilities, and provide a location where research and development can occur to sufficiently advance the state of the art of UAS so that someday soon UAS may be full participants in civil airspace operations around the globe. Only by working cooperatively across organizations and geographic boundaries can the challenges of UAS civil operations be effectively solved. The UAS capabilities at NASA's Dryden Flight Research Center are one tool the international community has at its disposal.